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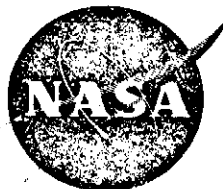
APOLLO APPLICATIONS PROGRAM

PROGRAM DIRECTIVE NO. 5

FLIGHT MISSION DIRECTIVE

FOR

AAP-3/AAP-4



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

APOLLO APPLICATIONS
PROGRAM DIRECTIVE NO. 5

TO : Distribution

FROM:

Charles W. Smith
DIRECTOR, SAA PROGRAM

SUBJECT: Flight Mission Directive for Mission AAP-3/AAP-4

REF : (a) Apollo Applications Flight Mission Assignments Directive
M-D ML 3200.056 dated January 1967
(b) Apollo Applications Planning Schedule ML-5B dated 12/5/66
(c) Apollo Flight Mission Assignments Directive M-D MA 500-11
dated November 1966
(d) Apollo Test Requirements, NPC 500-10, dated 5/20/64
(e) Apollo Program Directive No. 6A dated 8/30/66
(f) Apollo Program Directive No. 15 dated 1/25/66

PURPOSE: This Directive defines AAP requirements and responsibilities to initiate those actions prerequisite to execution of the AAP-3/AAP-4 Mission authorized in reference (a). The mission is scheduled for launch as indicated in reference (b) in the event that the launch vehicles and spacecraft assigned to the Apollo-Saturn 209 and 210 Missions, reference (c), are not required to support the mainline Apollo Program.

1.0 MISSION PURPOSE

The purposes of Mission AAP-3/AAP-4 are to:

- a. Increase man's knowledge of the characteristics of the sun by conducting solar astronomy observations in space during a time of solar maximum activity.
- b. Conduct an operational evaluation of the performance characteristics of a manned solar astronomy system to provide engineering and scientific data essential to the development of advanced orbital solar and stellar observation systems.

- c. Demonstrate feasibility of:
- (1) Reactivating an Orbital Workshop that has been left unattended in earth orbit for several months.
 - (2) Reusing it as a base of operations for the conduct of experiments in solar astronomy, science, applications, technology, engineering and medicine.
- d. Qualify man, evaluate his support requirements and determine human task performance capabilities on long duration manned space flight missions.

2.0 MISSION OBJECTIVES

- 2.1 Primary Objectives: The primary objectives of the Mission AAP-3/AAP-4 are listed below. They may be amplified but not modified by the centers. Preflight malfunctions of spacecraft or launch vehicle systems, ground equipment or instrumentation which would result in failure to meet these objectives will be cause to hold or cancel the mission until the malfunction has been eliminated.
- a. Obtain scientific data on the physical characteristics of the sun through observations of various portions of the electromagnetic spectrum made with the Apollo Telescope Mount (ATM) experiments. (Experiments - S052, S053, S054, S055, S056.)
 - b. Obtain engineering data for selected modes of operation of the ATM attached to a Lunar Module (LM) ascent stage to support development of an advanced manned orbital observatory.
 - c. Demonstrate hard-dock of the LM/ATM to the Multiple Docking Adapter of the Orbital Workshop, left in orbit from Mission AAP-1/AAP-2.
 - d. Determine feasibility of reactivating and operating the Orbital Workshop (Experiment M402) as a habitable space structure for a period of up to 56 days from the AAP-3 launch date through evaluation of the CSM/S-IVB/Airlock/Multiple Docking Adapter to include the following:
 - (1) Subsystems performance
 - (2) Astronaut mobility and work capability in both intra- and extra-vehicular activity

- e. Obtain data to evaluate space flight environmental effects on the crew of a mission duration up to 56 days. (Experiments - M050, M051, M052.)
- f. Leave the LM/ATM and the Orbital Workshop docked in orbit for future reuse and refurbishment.
- g. Verify the ability of mission ground support systems to support mission activities of extended duration.

2.2 Secondary Objectives: The secondary objectives of Mission AAP-3/AAP-4 are summarized below. Preflight malfunctions of spacecraft or launch vehicle systems, ground equipment or instrumentation which would result in failure to meet these objectives may be cause to hold or cancel the mission as specified in the Mission Rules.

- a. Obtain data prerequisite to identification of earth resources and development of improved cartographic procedures. (Experiment - S065.)
- b. Obtain data prerequisite to a more complete understanding of the physical characteristics of the extra-atmospheric environment. (Experiments - S018, S063.)
- c. Obtain engineering and technological data needed for development of advanced space vehicles and equipment. (Experiments - M439, T017, T021.)
- d. Obtain data in the areas of bioscience, medicine and astronomy. (Experiments - S015, S069, S019, S070, S027, S061, M053, M055, M018.)

3.0 GENERAL FLIGHT PLAN

3.1 Launch Vehicle Powered Flight:

- a. AAP-3 is a manned flight involving SA-209, CSM 108 and resupply provisions as needed to sustain a 56-day mission. It will be launched from LC 34 at KSC at a time and azimuth to facilitate rendezvous with the Orbital Workshop launched on AAP-1/AAP-2.

- b. AAP-4 is an unmanned flight involving SA-210, the ascent stage of LM 6 and the ATM. It will be launched from LC 37B at KSC at a time and azimuth to facilitate rendezvous with the CSM from AAP-3 and subsequent transfer by the CSM to the Orbital Workshop.
- c. Orbit altitudes and launch azimuths are to be specified in subsequent issues of this Directive.

3.2 Spacecraft Flight Profile: The AAP-3 spacecraft will be injected into an orbit that will facilitate rendezvous with the Orbital Workshop. The flight profile for rendezvous with the Orbital Workshop will be defined in subsequent issues of this Directive following an analysis to determine the optimum method of transfer of the LM/ATM and the resupply provisions by the CSM. Subsequent to rendezvous, the command module will be docked axially to the MDA and the LM/ATM will be docked radially to a port opposite the LM&SS.

3.3 Recovery: Water recovery to be developed consistent with the above stated profile characteristics and the normal recovery constraints associated with the deployment of recovery forces and the local lighting conditions at the time of recovery.

3.4 Mission Support Requirements: These requirements will be supplied in a "Program Support Requirements" document to be issued by the Operations Support Requirements Office, Mission Operations, OMSF, not later than four months prior to launch.

4.0 CONFIGURATION

4.1 Launch Vehicles: The launch vehicles for flights AAP-3 and AAP-4 will be those being developed for AS-209 and AS-210 respectively. They will be modified only as required to permit accomplishment of the respective mission objectives.

4.2 Nose Cone: An Apollo AS-206 type nose cone which will provide an aerodynamic shroud during the powered portion of flight AAP-4 will be utilized. It will be separated from the orbital payload after injection into orbit.

4.3 LM/ATM:

- a. The LM/ATM will consist of a solar observation experiment package and support subsystems mounted in place of the descent stage of the Apollo LM 6. The LM descent stage will not be utilized.
- b. The ATM consists of the following subsystems:
 - (1) Solar astronomy experiments.
 - (2) Rack and Experiments Package structure.
 - (3) Electrical power.
 - (4) Pointing control.
 - (5) Thermal control.
 - (6) Instrumentation and Communication.
- c. The lunar module ascent stage will be modified to incorporate the controls and displays for the operation of the ATM experiments and support subsystems.
- d. The LM/ATM shall be capable of:
 - (1) Operating docked to the Orbital Workshop in the primary mode.
 - (2) Operating docked to the CSM in a backup mode.
 - (3) Demonstrating operation remote from the cluster in either the tether or free-flight mode.
 - (4) Performing those operations peculiar to docking to the MDA.

Umbilical connections between the docked LM and the Airlock shall be provided for emergency power and expendables transfer from the Airlock.

4.4 CSM 108 will be a standard Block II Apollo configuration modified to:

- a. Operate with the Airlock and perform repetitive dockings to the MDA as dictated by mission requirements.
- b. Effect delivery to the Orbital Workshop of the resupply provisions required to extend the mission duration up to 56 days.
- c. Carry and support experiment hardware.
- d. Carry the Apollo experiment Airlock.

- 4.5 Resupply Provisions: Resupply provisions needed to sustain the AAP-3/AAP-4 Orbital Workshop mission of 56 days duration, in addition to those supplies remaining on the Airlock from AAP-1/AAP-2, will be carried in the AAP-3 command and service modules.

5.0 EXPERIMENTS

The experiments which have been approved for execution on AAP-3/AAP-4 (reference (a)) are identified below as they pertain to accomplishment of the primary and secondary mission objectives respectively.

5.1 Primary Objective Experiments:

<u>Flight No.</u>	<u>Exp. No.</u>	<u>Title</u>	<u>Dev. Center</u>
<u>Science</u>			
AAP-4	S052	White Light Coronagraph	MSFC
AAP-4	S053	UV Coronal Spectrographs	MSFC
AAP-4	S054	X-ray Spectrographic Telescope	MSFC
AAP-4	S055	UV Spectrometers	MSFC
AAP-4	S056	Dual X-ray Telescopes	MSFC
<u>Medical</u>			
AAP-4	M050	Metabolic Activities	MSC
AAP-4	M051	Cardiovascular Function Assessment	MSC
AAP-3	M052	Bone and Muscle Changes	MSC

<u>Flight No.</u>	<u>Exp. No.</u>	<u>Title</u>	<u>Dev. Center</u>
		<u>Engineering</u>	
*	M402	Orbital Workshop	MSFC

5.2 Secondary Objective Experiments:

<u>Flight No.</u>	<u>Exp. No.</u>	<u>Title</u>	<u>Dev. Center</u>
		<u>Science</u>	
AAP-3	S027	Galactic X-ray Mapping	MSFC
AAP-3	S061	Potato Respiration	MSC
AAP-3	S065	Multiband Terrain Photography (Hand Held)	MSC
		<u>Medical</u>	
AAP-4	M053	Human Vestibular Function	MSC
AAP-4	M055	Time and Motion Studies	MSC
		<u>Engineering</u>	
AAP-3	M439	Star Horizon Automatic Tracking	MSC
		<u>Technology</u>	
*	T017	Meteoroid Impact and Erosion	MSC
*	T021	Meteoroid Velocity	MSC

Additional experiments which have been approved for execution by AAP but currently have no firm flight assignments are attached as Appendix 1.

* Left in orbit from AAP-1/AAP-2

6.0 SUPPORTING GROUND TEST CONSTRAINTS

Test program will be conducted in accordance with NPC 500-10 (reference (d)) as modified by the AAP/Development/Test Directive (to be issued) and appropriate test specifications. Mission Requirements documents prepared by the centers in support of these missions will identify the test constraints which must be lifted prior to mission execution.

- 6.1 Qualification: Components of the spacecraft, launch vehicles, nose cone, resupply expendables, flight experiment hardware and associated support systems whose failure would jeopardize either crew safety or the accomplishment of a primary mission objective (Category I or II) and which have not been flight tested will be ground qualified and/or certified prior to launch. Basic Apollo hardware which has been flight tested (i.e., LM ascent stage and CSM) will be subjected to additional ground qualification and/or certification tests as required to provide confidence in meeting the long duration and other pertinent AAP requirements.
- 6.2 Launch Vehicles: The following flight stage and acceptance tests will be performed:
- Manufacturing checkout of S-IB-209, S-IB-210, S-IVB-209, S-IVB-210, and IU's for 209 and 210.
 - Static test of S-IB-209, S-IB-210, S-IVB-209, S-IVB-210.
 - Post static checkout of S-IB-209, S-IB-210, S-IVB-209, and S-IVB-210.
 - KSC inspection tests of S-IB-209, S-IB-210, S-IVB-209, S-IVB-210, and IU's for 209 and 210.
- 6.3 Nose Cone: The following ground inspections and/or analyses will be performed:
- Structural verification analysis.
 - Quality acceptance inspection.
 - KSC inspection.
- 6.4 AAP Experiments: The following ground tests will be performed:
- Experiment development tests.
 - Payload integration tests of experiment and associated support systems with carriers.
 - Qualification tests for each experiment.
 - Factory checkout and acceptance test of experiment and associated support systems.
 - KSC prelaunch tests.

- 6.5 Spacecraft: The following major flight article ground tests will be performed on CSM 108:
- a. Qualification and/or certification tests on the basic Apollo CSM as required to meet the long duration and other pertinent AAP mission requirements.
 - b. Qualification tests for AAP peculiar subsystems modifications to verify operation for the AAP-3/AAP-4 Mission.
 - c. Factory checkout and acceptance tests.
 - d. KSC prelaunch tests.
- 6.6 LM/ATM: The LM/ATM shall be fully qualified to support manned operations in earth orbit. In support of this requirement, the following ground tests will be performed:
- a. Lunar module ascent stage:
 - (1) Manufacturing checkout and acceptance tests.
 - (2) Qualification and/or certification tests as required to meet the AAP mission requirements.
 - (3) KSC inspection tests.
 - b. ATM and modification kits for the LM:
 - (1) Development tests.
 - (2) Structural verification tests.
 - (3) "All-systems" integration tests.
 - (4) Vibration tests.
 - (5) Thermal vacuum tests.
 - (6) Qualification tests.
 - (7) Manufacturing checkout and acceptance tests.
 - (8) KSC inspection tests.

c. LM/ATM assembly:

- (1) Systems compatibility tests.
- (2) "All-systems" tests on systems which bridge the LM/ATM interface (including monitors and controls).
- (3) Prelaunch checkout tests.

6.7 Resupply Expendables Package: The following ground tests will be performed on resupply expendables packaged for utilization on this mission:

- a. Structural verification tests.
- b. Integrated systems tests.
- c. Qualification tests.
- d. Factory checkout and acceptance tests.
- e. KSC prelaunch tests.

6.8 Prior Flight Missions: All launch vehicle, spacecraft, LM and nose cone test anomalies resulting from all previous missions which could degrade or interfere with primary objectives will be evaluated and corrected prior to the launch of AAP-3 or AAP-4.6.9 Design Certification Review (DCR): An AAP DCR will be conducted to certify all new hardware and all changes from the standard Apollo hardware required for this mission. Basic Apollo hardware already certified in previous DCR's will be recertified as required to meet AAP extended life and/or performance requirements. This review will also include certification of experiments likely to affect flight worthiness, manned flight safety and/or mission primary objectives. The DCR shall be in accordance with Apollo Program Directive No. 6A (reference (e)) as to be modified for AAP.6.10 Certification: A Certification of Flight Worthiness (reference (d)) for each stage, IU, spacecraft, LM/ATM, and resupply packaging is required prior to shipment from the factory and after static firing if appropriate. In addition, experiments whose failure would jeopardize crew safety or the accomplishment of a primary mission objective (Cat I or II) will also require preparation of a COFW. Final updated and signed COFW's by the program managers will be required at the Flight Readiness Review and close-out of open items prior to launch will be in accordance with Apollo Program Directive No. 15 (reference (f)) as to be modified for AAP.

7.0 RESPONSIBILITIES

Center responsibilities for implementation of this mission are as follows:

7.1 MSFC:

- a. Provide the AS-209 and AS-210 launch vehicles and required vehicle and GSE modifications.
- b. Manage the ATM development and establish requirements for modification of the LM, as needed for ATM operational control.
- c. Develop assigned experiments and supporting hardware.
- d. Develop GSE as required for assigned experiments and the ATM.
- e. Integrate assigned experiments into the AAP-3 launch vehicle.
- f. Integrate all experiments designated for transport in the AAP-4 flight mission.
- g. Develop and integrate the nose cone with the AAP-4 payload.
- h. Conduct guidance and control dynamics analyses for the ground launched space vehicle configuration and develop the requisite launch vehicle guidance and control capability.
- i. Analyze the cluster maneuver dynamics for the AAP-3/AAP-4 Mission.
- j. Conduct analyses in coordination with MSC in the areas of instrumentation and communications, electrical power distribution and expendables distribution for the space module cluster configuration as required for development of the LM/ATM.
- k. Provide launch vehicle performance constraints, systems data and guidance support to MSC for mission planning.
- l. Provide technical support to MSC concerning crew training procedures and flight operations planning for the LM/ATM, Orbital Workshop reactivation, and the MSFC assigned/designated experiments.
- m. Provide operational support to MSC as required during AAP-3/AAP-4 flight operations.
- n. Provide technical support to MSC concerning expendable resupply requirements and hardware development as related to the Orbital Workshop and LM/ATM.

- o. Provide technical support to KSC as required during the acceptance, modification, prelaunch checkout and the launch phases of this mission.

7.2 MSC:

- a. Provide the CSM and associated GSE required for the AAP-3 Mission.
- b. Modify the LM ascent stage and the AAP-4 SLA as required by MSFC for the ATM.
- c. Define the resupply requirements and develop the resupply hardware to sustain a mission of up to 56 days duration.
- d. Develop assigned experiments and supporting hardware.
- e. Develop GSE as required for assigned experiments and the LM.
- f. Integrate assigned experiments with the AAP-3 spacecraft.
- g. Conduct LM/ATM operations.
- h. Conduct thermal balance analyses for the AAP-3/AAP-4 orbital assemblage.
- i. Conduct analyses in coordination with MSFC in the areas of instrumentation and communications, electrical power distribution and expendables distribution for the space module cluster configuration as required for development of the CSM and resupply package hardware.
- j. Plan the mission to include mission design and develop the astronaut flight plan with appropriate inputs from MSFC for the Workshop, LM/ATM and MSFC assigned experiments.
- k. Plan and execute flight control, experiment and recovery operations.
- l. Train the astronaut crew.
- m. Provide technical support to KSC as required during the acceptance, modification, checkout, prelaunch and launch phases of this mission.

7.3 KSC:

- a. Prepare the GSE and conduct prelaunch checkout of the launch vehicles.
- b. Prepare the GSE and conduct prelaunch checkout of the spacecraft, resupply package hardware and experiment hardware for AAP-3.

- c. Install MSC and MSFC supplied kits and conduct modifications to Apollo hardware as required for execution at the launch site.
- d. Prepare the GSE and conduct prelaunch checkout of the LM/ATM and experiment hardware for AAP-4.
- e. Plan and execute space vehicle launch operations.
- f. Provide technical support as required to MSC and MSFC concerning the KSC implementation of modifications to flight hardware and GSE hardware.

8.0 IMPLEMENTATION

MSC, MSFC and KSC shall develop Mission Requirements documents to implement the requirements stated herein. The MSC/MSFC requirements will be combined in a jointly signed-off directive.

Subsequent changes and future revisions to center Mission Requirements documents noted above which conflict with the requirements stated herein will require coordination between the centers and the review and approval of the Saturn/Apollo Applications Program Director. Other revisions to the center Mission Requirements documents will be coordinated between centers as required with ten copies submitted to the Director, Saturn/Apollo Applications Program, Code ML, for information.

APPENDIX 1AAP-3 and AAP-4 Experiments

The experiments listed below have been assigned by AA/MSF to AAP for implementation on AAP missions. They are categorized as secondary mission objective experiments for the AAP-3 and AAP-4 flights. Firm flight assignments will be made on conclusion of compatibility studies now in progress.

<u>Experiment Number</u>	<u>Experiment Title</u>	<u>Development Center</u>
S015	Zero-G Single Human Cells	MSC
S069	X-ray Astronomy	MSC
S018	Micrometeorite Collection	MSC
S019	UV Stellar Astronomy	MSC
S070	UV X-ray Solar Photography	MSC
S063	UV Airglow Horizon Photography	MSC
M018	Vectorcardiogram	MSC

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MAS/Thompson (8)
MAT/Day (5)
MB/Armstrong
MC/Freitag
MCL/Ashley
MF/Evans
MF/Coulter (2)
MM/Bollerud (2)
MM/McLaughlin
M-N/Alibrando
MO/Stevenson (5)
MOR/Brown (10)
MP/Lilly (2)
MPP/Rafel (2)
MPR/Johnson
MS/Cotton
MSR/Davis
MT/Gray (9)
MTD/Lord
MTE/Raffensperger
MTL/Culbertson
MTL/Beattie
MTX/George
MTX/Hall
MTX/Werner
MTY/Dixon
MIS/Hall
MAS/Penn

ML/Mathews

MLD/Disher
ML-1/Levenson
MLV/Fero
MLA/Taylor

Andrews

Fordyce

Green

Hanes

Krueger

Lundholm

MLO/Edwards (5)

MLP/Field

Fahs

Lann

LeBert-Francis

Lewis

Lievens

Mason

Miller

Nicholas

VonSaunders

Williams

MLP-4/Koutsandreas

Craven

Kieffer

Van Schaack

Yetter

MLP-5/Poore

Little

Sprince

Sylvia

MIR/Cohen

MLS/Hagner

Anderson

Havenstein

Strack

Crowe

Martersteck

McFarland

MLT/Savage

D'Onofrio

Albert

Bumgardner

LaRock

Marsh

Roberts

Sperry

Summerfelt

Allen

Christianson

Frandsen

Pruett

Wong

Schrock

OSSA

S/Newell

SD/Cortright

SE/Garbarini

SV/Johnson

SM/Foster (5)

SL/Nicks

SS/Naugle

SG/Mitchell

SG/Forsythe

SA/Jaffe

SB/Reynolds

OART

R/Adams

R/Eggers

RD/Myers

RA/Harper

RB/Jones

RP/Tischler

RV/Ames

RE/Sullivan

RN/Finger

RND/Woodward

RNV/Novik (5)

OTDA

T/Buckley
TD/Truszynski
TA/Morrison
TS/Pozinsky
TR/Bryant

PT/Maggin

GSFC

500/Covington
512/Roberts
513/Vonbun

KSC

AA/Debus
AB/Siepert
GA/VanStaden
DF/Hock
DF/Raffaelli (60)
HA/Petrone
DA/Shinkle
CA/Murphy
MA/Bagnulo
MA/Clark
RA/Parker

MSC

AA/Gilruth
AB/Low
AD/West
KA/Thompson (40)
PA/Shea
EA/Faget
TA/Piland
ET/Stoney
FA/Kraft (2)
GA/Slayton
AH/Berry
FA4/Fielder
BM6/Tash (5)

MSFC

DIR/von Braun
DEP-T/Rees
EX/Maus
I-DIR/O'Connor
I-S/AA-MGR/Belew (5)
I-S/AA/Reinartz
I-S/AA/Ferguson
I-S/AA/Ise
I-S/AA/Clingman
I-I/IB-MGR/Teir
I-V-MGR/Rudolph
I-S/AA-T/Chambers
R-RP/Stuhlinger
R-AS/Williams
R-AERO-D/Horn
I-DIR/Mrazek
I-MO/Speer
I-RM-M/Goldston (60)
(Data Manager)

MSC

CB/Astronauts' Office (4)
CF/North (2)
CF32/Jones (2)
FC/Hodge (8)
FM/Mayer (2)
FM14/Parten (3)
FL/Hammack
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